# *Appendix G6*
# *Air Quality – Health Risk Analysis of Onshore Pipeline Construction*

# 1. INTRODUCTION

The Applicant conducted a screening-level health risk analysis (HRA) to estimate potential acute and long-term health risks associated with air toxic contaminants emitted from diesel-fueled equipment that would be used during Project-related shore crossing construction and onshore pipeline installation. Health risk impacts were evaluated for the following four construction activity scenarios:

1. Trenching (part of onshore pipeline installation);
2. Pipelay (part of onshore pipeline installation);
3. Drilling (part of onshore pipeline installation); and
4. Shore Crossing Construction

Boring (part of onshore pipeline installation), which uses similar equipment as Drilling, was not included in the HRA. Emissions from Drilling are projected to be greater in quantity but similar in composition than emissions from Boring, therefore the HRA for Drilling represents “worst-case risk” between these two activities.

# 2. METHODOLOGY

Acute and long-term (70-year cancer) risks were evaluated using the Hotspots Analysis and Reporting Program (HARP), which is a computer software package maintained by the California Air Resources Board (CARB). HARP combines the tools of emission inventory database, facility prioritization, air dispersion modeling, and risk assessment analysis. The air dispersion analysis component of HARP utilizes the United States Environmental Protection Agency’s Industrial Source Complex - Short-Term model (ISCST). The HARP risk analysis tool follows the *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* developed by CARB's Office of Environmental Health Hazard Assessment. HARP integrates the results of air dispersion analysis with the risk analysis tool so that the risk calculations are performed within the same program.

# 3. MODEL INPUTS

## 3.1 Source Descriptions

A summary of the diesel-fueled equipment for each construction activity is presented in Table 1. This table includes the total hourly diesel fuel rate for each activity that was used to estimate exhaust stack parameters.

## 3.2 Stack Parameters

For the HRA, the various internal combustion engines used in equipment and vehicles were consolidated into a single source. Thus, air pollutants from all internal combustion engines were assumed to be emitted from a single "virtual stack" for each construction activity scenario. The parameters of the "virtual stack" were set so that the height, exit velocity, and exit temperature would be roughly equivalent to the same parameters for the average engine stack. A summary of stack parameters is presented in Table 2.

### 3.3 Emission Rates

Air toxic emissions from diesel-fueled equipment were calculated using the total hourly diesel fuel usage for each construction activity and emission factors developed as part of California's Air Toxics "Hot Spots" Information and Assessment Act (AB2588 Program). A summary of air toxic emission rates for each stack is presented in Table 3.

### 3.4 Receptors

Health risks were evaluated at receptor locations input into HARP. Receptors were located within placed on a 1.5-km by 1.5-km grid, centered on the stack location, with spacing between receptors of 25 meters.

### 3.5 Meteorological Data

HARP was run with one year (1993) of meteorological data from the following Ventura County Air Pollution Control District monitoring stations:

- Simi Valley (for Trenching and Pipelay); and
- Ventura (for Drilling and Shore Crossing).

## 4. RESULTS

The screening-level HRA evaluated acute and long-term impacts from emissions caused by diesel-fueled equipment used during Project construction. Acute impacts were calculated directly by HARP. For long-term impacts, this analysis considered 70 years of exposure whereas the duration of each construction activity is less than 1 year. Therefore, the 70-year cancer risk was adjusted based on the actual length of each activity.

A comparison of maximum risk calculated in the HRA to appropriate significance levels is presented in Table 4. The acute hazard index for each construction activity is less than the significance level of 1.0. All adjusted long-term cancer risk values are less than the significance level of 1:1,000,000 ($10^{-6}$). The adjusted cancer risks for Pipelay and Trenching are considered conservative. The long-term cancer risks assume the activity's equipment remains in a fixed location during the entire job. However, the Pipelay and Trenching equipment moves along the length of the pipeline route and is in a given location for only a few hours.

**Table 1**
**Summary of Each Construction Activity**

| Activity | Equipment Type | No. of Devices | Mileage (mi/day) | Engine Rating per Device (bhp) | Daily Operation (hr/day) | Average Load | Working Days | Daily Output (bhp-hr/day or mi/day) | Fuel Use Rate (Btu/bhp-hr or Btu/mi) | Daily Fuel Input (MMBtu/day) | Hourly Fuel Usage (gal/hr) | Total Fuel Usage (gal) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Trenching** | Trenching Machine | 1 | | 1,000 | 12 | 80% | 180 | 9600 | 6,860 | 65.85 | 40.0 | 86,505 |
| | Track Backhoe | 1 | | 500 | 12 | 80% | 180 | 4800 | 6,860 | 32.93 | 20.0 | 43,253 |
| | Front Loader | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Bulldozer | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Dragline | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | **TOTAL** | | | | | | | | | | **75** | **162,197** |
| **Pipelay** | Dump Truck | 2 | 60 | | 4 | | 180 | 120 | 27,406 | 3.29 | 6.0 | 4,320 |
| | Water Truck | 2 | 60 | | 4 | | 180 | 120 | 27,406 | 3.29 | 6.0 | 4,320 |
| | Utility Truck | 2 | 60 | | 4 | | 180 | 120 | 27,406 | 3.29 | 6.0 | 4,320 |
| | Heavy Fork Lift | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Lowboy Truck | 4 | 120 | | 8 | | 180 | 480 | 27,406 | 13.15 | 12.0 | 17,280 |
| | Pipe Stringing Truck (mi/day) | 2 | 60 | | 4 | | 180 | 120 | 27,406 | 3.29 | 6.0 | 4,320 |
| | Sideboom Tractor | 2 | | 200 | 12 | 50% | 180 | 2400 | 6,860 | 16.46 | 10.0 | 21,626 |
| | Mobile Crane | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Pipe Bending Machine | 1 | | 100 | 12 | 50% | 90 | 600 | 6,860 | 4.12 | 2.5 | 2,703 |
| | Hydrostatic Test Pump | 1 | | 200 | 12 | 50% | 30 | 1200 | 6,860 | 8.23 | 5.0 | 1,802 |
| | Fill Dirt Screener | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Sheepsfoot Compactor | 1 | | 200 | 12 | 50% | 180 | 1200 | 6,860 | 8.23 | 5.0 | 10,813 |
| | Cement Truck | 2 | 60 | | 4 | | 90 | 120 | 27,406 | 3.29 | 6.0 | 2,160 |
| | Cement Pump | 1 | | 100 | 12 | 50% | 90 | 600 | 6,860 | 4.12 | 2.5 | 2,703 |
| | Asphalt Truck | 2 | 60 | | 4 | | 90 | 120 | 27,406 | 3.29 | 6.0 | 2,160 |
| | Asphalt Paving Machine | 1 | | 200 | 12 | 50% | 90 | 1200 | 6,860 | 8.23 | 5.0 | 5,407 |
| | Asphalt Roller | 1 | | 100 | 12 | 50% | 90 | 600 | 6,860 | 4.12 | 2.5 | 2,703 |
| | **TOTAL** | | | | | | | | | | **96** | **119,077** |
| **Drilling** | Large Drilling Rig (HDD) | 2 | | 500 | 24 | 80% | 30 | 19200 | 6,860 | 131.71 | 40.0 | 28,835 |
| | Mud Cleaner Generator | 1 | | 400 | 24 | 80% | 30 | 7680 | 6,860 | 52.68 | 16.0 | 11,534 |
| | Mud Pumps | 2 | | 500 | 24 | 80% | 30 | 19200 | 6,860 | 131.71 | 40.0 | 28,835 |
| | Fluid Handling Pumps | 4 | | 75 | 24 | 80% | 30 | 5760 | 6,860 | 39.51 | 12.0 | 8,651 |
| | Track Backhoe | 1 | | 200 | 12 | 50% | 30 | 1200 | 6,860 | 8.23 | 5.0 | 1,802 |
| | All Terrain Forklift | 1 | | 100 | 12 | 50% | 30 | 600 | 6,860 | 4.12 | 2.5 | 901 |
| | Light Towers | 6 | | 20 | 12 | 100% | 30 | 1440 | 6,860 | 9.88 | 6.0 | 2,163 |
| | Heavy Lift Crane | 1 | | 500 | 6 | 50% | 30 | 1500 | 6,860 | 10.29 | 12.5 | 2,253 |
| | 18 Wheeler Truck (mi/day) | 2 | 60 | | 4 | | 30 | 120 | 27,406 | 3.29 | 6.0 | 720 |
| | **TOTAL** | | | | | | | | | | **140** | **85,693** |
| **Shore Crossing** | In-hole head drive unit | 1 | | 400 | 6 | 100% | 88 | 2400 | 6,860 | 16.46 | 10.0 | 10,573 |
| | Mud pumps | 2 | | 400 | 9 | 100% | 88 | 7200 | 6,860 | 49.39 | 30.0 | 31,719 |
| | Solids control unit | 1 | | 500 | 8 | 100% | 88 | 4000 | 6,860 | 27.44 | 16.7 | 17,621 |
| | Thrusting apparatus | 1 | | 300 | 6 | 100% | 88 | 1800 | 6,860 | 12.35 | 7.5 | 7,930 |
| | Electrical generator | 1 | | 400 | 24 | 80% | 85 | 7680 | 6,860 | 52.68 | 16.0 | 32,680 |
| | All Terrain Forklift | 1 | | 100 | 12 | 30% | 60 | 360 | 6,860 | 2.47 | 0.8 | 1,081 |
| | Mobile crane | 1 | | 400 | 7.2 | 80% | 85 | 2304 | 6,860 | 15.81 | 4.8 | 9,804 |
| | Welding machines | 3 | | 100 | 12 | 80% | 85 | 2880 | 6,860 | 19.76 | 6.0 | 12,255 |
| | Exit Hole Barge Tug | 1 | | 4,000 | 24 | 5% | 35 | 4800 | 6,860 | 32.93 | 10.0 | 8,410 |
| | AHTS | 1 | | 15,000 | 24 | 10% | 35 | 36000 | 6,860 | 246.95 | 75.1 | 63,077 |
| | *Contingency | 1 | | 700 | 24 | 100% | 60 | 16800 | 6,860 | 115.25 | 35.0 | 50,461 |
| | 18 Wheeler Truck (mi/day) | 2 | 60 | | 4 | | 60 | 120 | 27,406 | 3.29 | 6.0 | 1,440 |
| | **TOTAL** | | | | | | | | | | **218** | **247,051** |

**Table 2**
**Summary of Stack Parameters**

| Activity | Stack Height (m) | Stack Temperature (K) | Stack Velocity (m/s) | Stack Diameter (m) |
|---|---|---|---|---|
| Trenching | 2.5 | 700 | 45 | 0.451 |
| Pipelay | 2.5 | 700 | 45 | 0.543 |
| Drilling | 4 | 700 | 45 | 0.610 |
| Shore Crossing | 4 | 700 | 45 | 0.439 |

**Table 3**
**Summary of Emission Rates**

| Pollutant | Emission Factor[a] (lb/1000-gal) | Hourly Emissions (lb/hr) | | | | Annual Emissions (lb/yr) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Trenching | Pipelay | Drilling | Shore Crossing | Trenching | Pipelay | Drilling | Shore Crossing |
| Benzene | 0.1863 | 0.014 | 0.0178 | 0.0261 | 0.0406 | 30.2 | 22.2 | 16 | 46 |
| Toluene | 0.1054 | 0.00791 | 0.0101 | 0.0148 | 0.023 | 17.1 | 12.6 | 9.03 | 26 |
| Xylenes | 0.0424 | 0.00318 | 0.00405 | 0.00594 | 0.00924 | 6.88 | 5.05 | 3.63 | 10.5 |
| PAHs (w/ napthalene) | 0.0559 | 0.0042 | 0.00534 | 0.00784 | 0.0122 | 9.07 | 6.66 | 4.79 | 13.8 |
| Chlorobenzene | 0.0002 | 0.000015 | 0.0000191 | 0.000028 | 0.0000436 | 0.0324 | 0.0238 | 0.0171 | 0.049 |
| Hexane | 0.0269 | 0.00202 | 0.00257 | 0.00377 | 0.00586 | 4.36 | 3.2 | 2.31 | 6.65 |
| Ethyl Benzene | 0.0109 | 0.000818 | 0.00104 | 0.00153 | 0.00238 | 1.77 | 1.3 | 0.934 | 2.7 |
| Hydrogen Chloride | 0.1863 | 0.014 | 0.0178 | 0.0261 | 0.0406 | 30.2 | 22.2 | 16 | 46 |
| Arsenic | 0.0016 | 0.00012 | 0.000153 | 0.000224 | 0.000349 | 0.26 | 0.191 | 0.137 | 0.395 |
| Cadmium | 0.0015 | 0.000113 | 0.000143 | 0.00021 | 0.000327 | 0.243 | 0.179 | 0.129 | 0.37 |
| Total Chromium | 0.0006 | 0.0000451 | 0.0000573 | 0.0000841 | 0.000131 | 0.0973 | 0.0714 | 0.0514 | 0.15 |
| Hexavalent Chromium | 0.0001 | 0.00000751 | 0.00000956 | 0.000014 | 0.0000218 | 0.0162 | 0.0119 | 0.00857 | 0.025 |
| Copper | 0.0041 | 0.000308 | 0.000392 | 0.000575 | 0.00089 | 0.665 | 0.488 | 0.351 | 1.0 |
| Lead | 0.0083 | 0.000623 | 0.000793 | 0.00116 | 0.00181 | 1.35 | 0.988 | 0.711 | 2.05 |
| Manganese | 0.0031 | 0.000233 | 0.000296 | 0.000435 | 0.000676 | 0.503 | 0.369 | 0.266 | 0.766 |
| Mercury | 0.0020 | 0.00015 | 0.000191 | 0.00028 | 0.000436 | 0.324 | 0.238 | 0.171 | 0.49 |
| Nickel | 0.0039 | 0.000293 | 0.000373 | 0.000547 | 0.000850 | 0.633 | 0.464 | 0.334 | 0.96 |
| Selenium | 0.0022 | 0.000165 | 0.00021 | 0.000308 | 0.00048 | 0.357 | 0.262 | 0.189 | 0.54 |
| Zinc | 0.0224 | 0.00168 | 0.00214 | 0.00314 | 0.00488 | 3.6 | 2.67 | 1.92 | 5.5 |
| Propylene | 0.4670 | 0.0351 | 0.0446 | 0.0655 | 0.102 | 75.7 | 55.6 | 40 | 115 |
| Formaldehyde | 1.7261 | 0.13 | 0.165 | 0.242 | 0.376 | 280 | 206 | 148 | 426 |
| Acetaldehyde | 0.7833 | 0.0588 | 0.0749 | 0.11 | 0.171 | 127 | 93.3 | 67.1 | 194 |
| Acrolein | 0.0339 | 0.00255 | 0.00324 | 0.00475 | 0.00739 | 5.5 | 4.04 | 2.91 | 8.4 |
| 1,3-Butadiene | 0.2174 | 0.0163 | 0.0208 | 0.0305 | 0.047 | 35.3 | 25.9 | 18.6 | 54 |
| Diesel Exhaust Particulates[b] | - | 1.333 | 0.917 | 2.08 | 3.625 | 2873 | 1625 | 1498 | 4341 |

Notes:

a. Emission factors for combustion of diesel fuel in internal combustion engines were developed for use in AB 2588 emission inventory reports.

b. Emissions based on emission calculations of $PM_{10}$ from Project construction activities (see Appendix G1).

**Table 4**

**Summary of Stack Parameters**

| Activity | Acute Risks | | HARP Output: 70-Year Cancer Risk[b] | Duration of Activity (days) | Risk Adjustment Factor[c] | Long-Term Risks | |
|---|---|---|---|---|---|---|---|
| | Acute Risk Hazard Index | Significance Level[a] | | | | Adjusted Cancer Risk[d] | Significance Level[a] |
| Trenching | 0.246 | 1.0 | 4.55E-05 | 180 | 0.0070 | 3.2E-07 | 1.0E-06 |
| Pipelay | 0.265 | 1.0 | 1.49E-05 | 180 | 0.0070 | 1.0E-07 | 1.0E-06 |
| Shore Crossing | 0.241 | 1.0 | 7.53E-05 | 60 | 0.0023 | 1.8E-07 | 1.0E-06 |
| Drilling | 0.070 | 1.0 | 9.57E-06 | 30 | 0.0012 | 1.1E-08 | 1.0E-06 |

Notes:

a. Significance levels from South Coast Air Quality Management District Rule 1401.

b. HARP Output assumes continuous source of emissions (24 hr/day, 365 day/yr) over a 70-year period.

c. Risk adjustment factor was calculated to account for temporary nature of construction emissions.

Risk Adjustment Factor = (Duration of Activity / 365 days) / 70 Years

d. Adjusted Cancer Risk = HARP Output: 70-Year Cancer Risk x Risk Adjustment Factor